

JPRS 80248

5 March 1982

# Worldwide Report

NUCLEAR DEVELOPMENT AND PROLIFERATION

No. 134



FOREIGN BROADCAST INFORMATION SERVICE

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ISRAEL'S ALLEGED WARNING REPORTED

Peshawar KHYBER MAIL in English 28 Jan 82 p 1

[Text]

NEW YORK, Jan. 27: Defence Minister Ariel Sharon says Israel was determined to "prevent the confrontation states or potentially confrontation states from gaining access to nuclear weapons".

Mr. Sharon said this in a speech prepared for delivery last month at a conference at Tel Aviv University, parts of which were published by the New York Times.

But, according to the Times, the Israeli Defence Minister never got the chance to deliver it because he had to be in parliament for votes on the annexation of the Occupied Syrian Golan Heights.

Correspondent Leslie H. Belk said what Mr. Sharon meant was that Israel would repeat its attack on an Iraqi nuclear reactor near Baghdad or against comparable plants in other Arab nations.

"Because the speech also said that Pakistan was considered one of Israel's strategic concerns, this policy could be interpreted as including Pakistan," according to the Times' despatch from Washington.

It added: "the Pakistanis are generally believed to be close to building a nuclear weapon (something vehemently denied

by Pakistanis), and Israelis fear this bomb might be put at the disposal of other Islamic nations."

The despatch said that the central theme of Mr. Sharon's speech was his doctrine of "red lights," using force first when danger signals appear.

The speech introduced the concept of the "safety valve," what Mr. Sharon termed "our resolve and our ability to prevent the disruption of the territorial military status in neighbouring countries." The emphasis throughout the speech was on taking action before any threat fully materialized.

Mr. Sharon, outlining the aims of that policy, said Israel would "prevent the violation of security arrangements laid down in political agreements such as in the Sinai with Egypt, and the Golan with Syria."

He said it would also "prevent any violation of the status quo in South Lebanon."

Mr. Sharon went on to say that Israel would "prevent any change in the geographical-military status of the confrontation area which might present unacceptable threats, such as the massive introduction of Iraqi forces into Jordan or Southern Syria or Syrian forces into Jordan."

CSO: 5100/5622

PAKISTAN

BRIEFS

PIRAGHA DENIES BOMB RUMORS--Tokyo, Feb 11--Pakistan Foreign Secretary Riaz Piracha said here yesterday that sixth round of bilateral consultation with Japan was most fruitful and had further strengthened the already existing friendly relations between the two countries. Talking to newsmen at embassy premises yesterday morning he categorically denied that Pakistan was developing a nuclear bomb. He declared that it was Zionist propaganda against Pakistan and Islam which stood for peace in the world. He said Pakistan's nuclear development programme was modest and geared entirely to peaceful use of nuclear energy. He added that his Government was giving top priority to improvement in the living standard of the people of Pakistan and complimented Japan for its large contribution of aid. [Excerpt] [Karachi DAWN in English 12 Feb 82 p 1]

CSO: 5100/5624

INTER-AMERICAN AFFAIRS

BRIEFS

CNEA HEAD ON PERU, BRAZIL DEALS--Cordoba, (NA)--The "Embalse" nuclear power centre at Rio Tercero, Cordoba Province will begin to operate by the end of this year "barring unforeseen problems," the president of the National Atomic Energy Commission (CNEA), Carlos Castro Madero declared on Friday. "The necessary funds will be appropriated" for the completion of the nuclear centre as well as for a heavy water plant at Arroyito in Neuquen Province, Castro Madero explained. But other CNEA projects "might suffer some setbacks" as a result of government austerity measures, he added. Castro Madero, who made his remarks to reporters on Friday during a visit to the Embalse construction site, said that negotiations between CNEA and the Cordoba government concerning the eventual distribution of electricity from the nuclear complex are already underway. Concerning CNEA's international dealings, Castro Madero said that the construction of a nuclear complex in Peru, which is being overseen by CNEA, is progressing "at a good pace" now that problems involving the awarding of contracts have been overcome. "With respect to Brazil," Castro Madero explained, "120 tons of uranium will be leased (to that country), according to the terms of the agreement (between Argentina and Brazil)." [Text] [PY220047 Buenos Aires HERALD in English 21 Feb 82 p 9]

CSO: 5100/2094

BARBADOS

BRIEFS

NUCLEAR REACTOR IN BARBADOS--Bridgetown, Barbados, 8 Feb (CANA)--The University of the West Indies (UWI) has bought a mini nuclear reactor from Canada for use in medical, environmental and other research work at a campus in Jamaica, the Canadian Government's publication CANADA WEEKLY has said. The reactor, of the safe, low-power critical experiment (slowpoke) type, cost the UWI 625,000 Canadian dollars. The publication said Canada would send a five-member team to Jamaica to install the reactor, which should be put into operation in about a year's time. [Except] [FL100235 Bridgetown CANA in English 2251 GMT 8 Feb 82]

CSO: 5100/2096

CONSTRUCTION OF IPEN UF<sup>6</sup> PLANT SIX MONTHS AHEAD

Rio de Janeiro GAZETA MERCANTIL in Portuguese 5 Feb 82 p 6

[Article by Paulo Ludmer]

[Summary] Sao Paulo--IPEN [Nuclear and Energy Research Institute] Superintendent Ernani Amorim has commented that the construction of the plant for the production of uranium hexafluoride (UF<sup>6</sup>) by the IPEN is six months ahead in relation to the 4-year timetable ending in March 1984 as a result of the adoption of metallic structures and pre-cast concrete. He noted that instead of operating the plant ahead of schedule, the IPEN intends to use the six months advance-time to perfect the tests. Noting that the process being developed by the IPEN for the production of 20 kg/h of UF<sup>6</sup> is the conventional one, Amorim said that the IPEN will not do enrichment but deal, with the instruments that it has, in the analysis of isotopic concentrations by means of mass spectrometry, namely the enrichment content of the materials and which isotopes are present. He commented that the IPEN agreement with the Ministry of Mines and Energy regarding the UF<sup>6</sup> plant has a contractual timetable of from 25 March 1980 to 25 March 1984, with investments, at June 1979 prices, totalling Cr\$200 million. He justified the choice of the hexafluoride process by the classic method by saying that "On an industrial scale it is the only one known and applied with success in the world," and he does not appear concerned with the virtual obsolescence of the classic process he is adopting.

Concerning the IPEN's production of uranium dioxide--with regard to which little is known publicly particularly with respect to its purpose--Amorim maintains absolute secrecy. He restricts his comment to "We are continuing production on the government stocks," adding that Laws 6,189 and 4,118, which require the country to maintain strategic stocks, are being carried out.

CSO: 5100/2095

BRAZIL

DAILY COMMENTS ON NUCLEAR PLANT PROBLEMS

PY130105 Rio de Janeiro LATIN AMERICA DAILY POST in English 12 Feb 82 pp 1, 5

[Special report to the DAILY POST by Tom Murphy]

[Text] Rio de Janeiro--"Obviously, we have to postpone inauguration of the Angra Dos Reis I nuclear plant," Westinghouse do Brasil President Ivan de Souza told the DAILY POST this week. "We want to be 101 percent sure of the plant's safety."

Brazil's \$1.3 billion venture into nuclear engineering, already 5 years behind schedule, is being threatened now with yet another delay.

This time the problem is fall-out from a series of accidents involving Westinghouse-built nuclear facilities, similar to Brazil's Angra Dos Reis I plant, in other parts of the world.

The most serious incident so far occurred at a Westinghouse-constructed plant in Ontario, New York. That accident was caused by a corroded pipe in the Robert E. Ginna nuclear power plant which resulted in the contamination of the atmosphere by low-level radioactive vapors when a safety valve vented steam from the broken vessel, one of 5,000 in the plant's system.

Both Brazilian and Westinghouse officials, contacted by the DAILY POST, fear the same thing could happen at the Angra Dos Reis I site in southern Rio de Janeiro State.

Originally contracted in 1972, Angra Dos Reis I was to have begun commercial operation in 1977. Five years later there is still no commercial start-up date set for the completed, but not yet fully tested, facility, whose 1972 price tag of \$300 million has ballooned up to an estimated \$1.3 billion.

"We expect a preliminary study from Westinghouse by the end of the month," says Licinio Seabra, president of FURNAS, the government-controlled electric power company which owns Angra Dos Reis I. "And then a definitive solution by, let's say, April. With another couple of months for the actual on-site work and then more tests I think we can still say that Angra I will be operating at 100 percent capacity before the end of the year." Despite the current difficulties, in fact, FURNAS has received permission from Brazil's Nuclear Energy Commission (CNEN) to proceed with the current round of tests at the 30 percent-of-capacity level.

one hundred percent capacity, when it is finally achieved, will mean 800 m<sup>3</sup> of electricity, equal to about 5 percent of ELETROS' total generating potential for the Rio-Minas Gerais region served by the utility. That's about half the wattage of each of the eight plants Brazil is buying from West Germany's Siemens group under terms of a 1975 deal made between the two governments. The total price tag for the German purchase is some \$2.5 billion for a technology transfer program—as opposed to the turn-key Westinghouse purchase—which should continue through the year 2000. The Angra Dos Reis 1 facility is the only one being built by Westinghouse in Brazil at the current time.

Seabra was alerted to apparent weaknesses in the Westinghouse plant's plumbing system by the CNEN at the end of last year. The commission's safety officials were acting on reports from the Swedish Nuclear Licensing Board indicating that a Westinghouse-built plant, Ringhals 3, in that country had shown evidence of cracks in its steel pipes.

"As soon as we were told about the problems in Sweden," says Seabra, "we asked Westinghouse to bring in their U.S. technicians. The technicians have inspected the site and we are now awaiting their report."

Since the Ringhals 3 cracks were found in Sweden a number of other, similar problems have been discovered in Westinghouse facilities throughout the world, including at two sites in Spain (Almaraz 1 and 2) and at various sites in the U.S.

"What should be kept in mind, however, is the fact that the Angra 1 site has not shown any actual problems yet," says Jose Colleberg, chairman of the University of São Paulo Physics Department. "What Westinghouse is doing in Brazil now is testing to see whether the Angra plant will or will not develop the kinds of cracks which developed in the Swedish plant and in the American plants."

According to Colleberg, "the best possible scenario would be the technicians finding no evidence of cracking, in which case they might recommend some additional safety measures but that's all. The worst possible scenario, which I personally find highly unlikely, is that they will recommend the replacement of the entire system of pipes."

Some Brazilian chemists, however, regard the worst-case scenario as one of the most likely outcomes. Federal University of Rio de Janeiro physicist Luiz Fernando Setteca de Oliveira said in a recently published interview that replacement of equipment at the Angra 1 site could cost "100 million or more because of the probable need to open a hole in the side of the building in order to move the old equipment out and the new equipment in."

Westinghouse do Brasil President De Souza disagrees, saying "100 million just doesn't make any sense; that figure is an absurd rumor designed to excite the Brazilian public."

Whether it's \$1 million or \$100 million Westinghouse will almost certainly end up footing the bill, however. According to ELETROS President Seabra, "Westinghouse will, of course, pay for any replacement equipment and man-hours involved. In addition, under the terms of our contract guarantee, we can bill them for post

direct costs to be caused by the delay. However, there are other costs, such as interest on loans for example, which FURNAS will end up paying."

Just as an extra guarantee that Westinghouse will, in fact, bear the added costs of the evaluation and, if indicated, repair of the facility, FURNAS has retained an estimate \$30 million in payments to the American manufacturer.

Westinghouse Do Brasil President de Souza, in any case, says he "endorses FURNAS' public statements" with respect to the current difficulties involving his company and the government-owned utility. Says de Souza, "FURNAS has always been a good customer."

AKL: 3100/2092

## WEEKLY VIEWS ARGENTINE NUCLEAR CAPABILITIES, INTENTIONS

Santiago ERCILLA in Spanish 3 Feb 82 pp 28-30

[Article by Emilio Meneses Ciuffardi]

[Summary] Argentina's nuclear program is progressing rapidly, and the possibility of a potential enemy's producing nuclear weapons is alarming. "Every country that aspires to be a nuclear power should have not only (a) the capacity to produce nuclear devices, but also (b) an adequate means of firing or delivering the weapons and (c) an appropriate strategic nuclear doctrine." Until Argentina either explodes an atomic bomb or announces and proves that it is capable of doing so, point "a" remains an unknown. Point "b" presupposes the existence of high precision missiles or bombers capable of penetrating enemy defenses. Argentina lacks adequate missile technology but it has airplanes (Mirage and Super Etandard) capable of carrying miniaturized tactical nuclear bombs. Although it lacks miniaturization capability, Argentina might be able to produce a larger, less advanced device that could be carried in a Canberra type aircraft. This, however, would create problems of precision, penetration and political strategy.

Strategic doctrine is the least clear point in the case of Argentina, since the country lacks cohesion in its government. Generally there are two types of nuclear strategy: "Dissuasion," in which the threat of devastation deters the enemy from initiation conflict and "battle" theories, in which nuclear weapons are used to destroy military targets. The disadvantages of dissuasion theories are that credibility declines over time, there is no alternative to peace except holocaust, other aspects of defense are neglected, and the enemy might not be dissuaded. "Battle" theories are more expensive, requiring high technology, strong political and military discipline, and clear objectives. No matter what alternative Argentina were to choose if it had a bomb, Brazil and Chile would also try to acquire one and an arms race would ensue.

Argentina has the means of developing a nuclear dissuasion strategy, but to do so would present strategic problems. It would expose the country's highly concentrated population and industry to retaliation. Moreover, because of geographic and wind conditions, an atomic explosion of any size near the Chilean metropolis would scatter radioactive fallout over populated Argentine territory. Brazil would present an even more serious problem--it is closer to Buenos Aires and its population is more diffused. A battle strategy would present technical and economic difficulties that could only be overcome over a long period, during which Argentina's

neighbors would, it is hoped, develop their own nuclear weapons and end Argentina's advantage. Argentina also lacks the political consensus that battle strategies require.

Argentina might be tempted to assume the status of a nuclear power. Such a step, however, would be impossible for Santiago and Brasilia to ignore, and it would initiate a Southern Cone arms race in which Argentina would stand to lose much.

CSO: 5100/2089

## BRIEFS

LEGISLATOR DISCUSSES NUCLEAR BUDGET--Lima, 30 Jan (TELAM)--The Peruvian Nuclear Energy Institute (IPEN) might increase its budget by 1 billion soles (\$1.9 million) to reinforce the national participation in the development of nuclear energy. Luis Percovich, chairman of the Chamber of Deputies, reported on the subject during a visit, together with other legislators, to the IPEN offices. Percovich said that the institute will receive approximately \$950,000 this year but that it will be necessary to double this amount in view of the large economic contribution which the Republic of Argentina has been making in this field through an agreement entered into with the Argentine National Atomic Energy Commission. Percovich also remarked on the importance of supporting the projects and research under way on the use of nuclear energy, for it will become the mainstay of the Peruvian industrial development in the future. The IPEN is currently building a nuclear research center in Huarangal, about 33 km east of Lima, with Argentine economic and technological assistance. A zero-power reactor was delivered to IPEN by Argentina many years ago to train specialized personnel. [Text] [PY022132 Buenos Aires TELAM in Spanish 1659 GMT 30 Jan 82]

CSO: 5100/2098

INTERNATIONAL AFFAIRS

STUDY: NORDIC NUCLEAR PLANTS HAVE LEAST RADIATION

Helsinki HUFVUDSTADSBLADET in Swedish 25 Jan 82 p 3

[Article by Bjorn Wahlstrom, licentiate of philosophy, from Lovisa: "Nordic Nuclear Power Plants Emit Least Radiation"]

[Text] Bjorn Wahlstrom, licentiate of philosophy, concludes that we Nordic residents can be satisfied with our nuclear power plants if we judge them by the radiation dose which, according to a 1981 study, is the lowest in the world.

One measure of "how good" a nuclear power plant is from the viewpoint of radiation protection is the total radiation dose the personnel receives. The sum of the radiation doses of all the people has a name, collective radiation dose, measured in man-rem units. It is usual in many parts of the world to calculate the annual collective radiation dose and to indicate this together with other results, in order to describe the previous year of operation. When the 1981 results are examined, it turns out that in this respect the Nordic nuclear power plants are many times better than the average. Of the Nordic power plants the Finnish ones show the best results.

The fact that many systems and components at nuclear power plants transport or contain radioactive processing fluids or are themselves radioactive results in a field of ionizing radiation, popularly called "radioactivity." During repairs and maintenance work the radiation constitutes an inconvenience which in many respects can be compared to other inconveniences occurring in the industry such as noise, heat, cold, fibers and particles in the air, chemical vapors, etc. Exposure to these in sufficiently low amounts involves no unacceptable risks, while, on the other hand, excessively high "exposure" can pose a health hazard or may even cause acute damage.

In order to safeguard the health of the employees and to protect the personnel against unacceptable increases in risk, limits for acceptable exposure to the various "environmental factors" have been established in law, by authorities or by internal organs. For ionizing radiation the norms of all countries are based on recommendations issued by the international organ ICRP [International Commission on Radiological Protection] founded as early as 1928 and still actively functioning today. The radiation limits were set so low that the health hazards connected with them correspond to the occupational hazards in jobs traditionally considered safe jobs.

## Actual Doses Only 10 Percent of Permitted Values

The radiation protection philosophy and activity set their goal higher than that, however. It is not enough to keep the individual radiation doses of the personnel within the permitted limits, but efforts are further to be made to completely avoid unnecessary radiation and to keep the inevitable doses as small as can reasonably be possible while taking economic and social considerations into account. Within the nuclear power industry this has succeeded so well that the actual radiation doses of the personnel, expressed as a global average, are 10-15 percent of the limits.

The individual radiation doses and the average value of the doses can always be lowered by increasing the number of workers, of course. However, this does not result in any advantages and no reduction in hazard, since the total amount of radiation absorbed by human tissue is not reduced in this manner. This is why the collective dose -- the sum of the radiation doses of all workers -- is the most adequate measurement of the safety of a radiological activity, such as a nuclear power plant, from the viewpoint of radiation protection.

## The Collective Dose 100 to 1,000 Man-Rem per Year

Recording and analyzing the radiation doses received is obviously of great interest. This has also been done for several decades. Experience shows that the collective annual dose in general is lowest at recently started power plants. After about 4 years of operation a value is reached which could be regarded as a steady state value. This value stabilizes at various levels depending on the type of reactor. Statistics from many hundreds of years of reactor operation have yielded the following average values:

-- 600 man-rem/year for boiling-water reactors (Olikiluoto 1 and 2 and most of the Swedish nuclear power plants are of this type).

-- 450 man-rem/year for pressurized-water reactors (for example Lovisa 1 and 2 and Ringhals 2, 3 and 4).

The greatest radiation doses are caused during repair and maintenance shutdowns. In normal operation the personnel is confronted by radiation to only an insignificant degree. The annual variation for individual plants can therefore vary considerably depending on the repair and reconstruction work. At a plant which in 1978 had a collective dose c. 117 man-rem, the dose in 1979 resulted in nearly 1,200 man-rem. At a German plant the collective dose during the first year of operation was 150 man-rem, during the second year of operation 1,300 man-rem and during the third year only 290 man-rem.

## Nordic Countries in the Lead, Finland Top

The annual global surveys are generally prepared with over a year's delay. Consequently, the most recent surveys are from 1979. The information for 1980 can be expected in March-April of this year. The Nordic operational experience for 1981 must thus be compared to global values for 1979. In Table 1 the annual average value for the collective dose at the U.S. commercial pressurized-water and boiling-water reactors is indicated for the years 1973 to 1979. (Reporting from the U.S. plants is

Normal Annual Average Values for the Light-Water Reactors, 450-600 Man-Rem

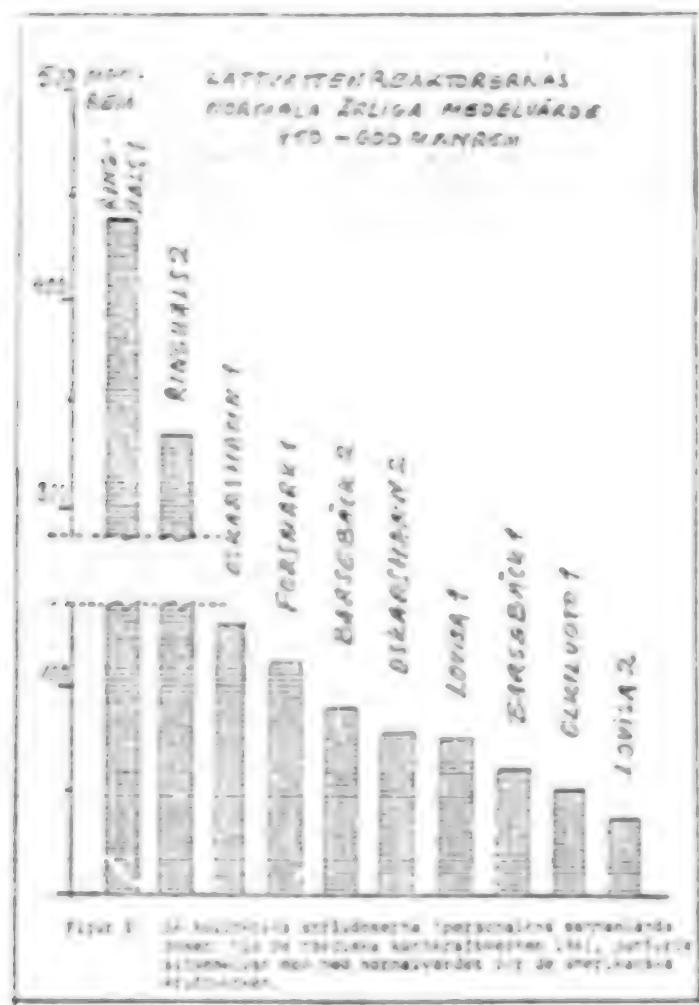


Figure 1. The collective radiation doses (the total doses of the personnel) at the Nordic nuclear power plants during 1981, compared with each other and with the normal values for the U.S. power plants.

more complete than from the East bloc or Central Europe). As a comparison the average value for the Nordic nuclear power plants, and separately for the Finnish ones, is indicated. Not included are the very newest power plants, which were started up in 1981 and which therefore have not yet undergone a refueling/annual maintenance shutdown. If they had been included the values would have dropped even more, but perhaps not in an honest manner.

Table 1: The average collective radiation doses at U.S. light-water reactors for 1973-1979 and at the Nordic and Finnish reactors in 1981.

Region	Year of Operation	Number of Plants	Average dose (man-rem)
United States	1973	24	582
	1974	34	404
	1975	44	475
	1976	53	499
	1977	57	570
	1978	64	497
	1979	67	593
Nordic countries	1981	10	139
Finland	1981	3	54

In the bar graph, Fig. 1, the collective doses of the Nordic power plants are compared both with the "world average value" and with each other. Ringhals 1, which in 1981 was hampered by extensive reconstruction work on certain pipeline systems, has the largest dose, but even so it barely reaches the "international" level. At Ringhals 2 a large proportion was contributed by the installation of so-called mirror shielding, which is not part of the annual routine. The other power plants are at a level which corresponds to one-fourth or one-fifth of the "normal value." All of the Finnish power plants manage to achieve two-digit values. Best of all is Lovisa 2 with its 36 man-rem, which might be unique for a light-water reactor that has been shut down for refueling and annual maintenance.

We Nordic residents can be pleased with our nuclear power plants, at least if the radiation dose is used as a measuring stick. Of course, we should not get up and beat our chests and shout "hurrah, we are good." We ought to be aware that in the future the values for individual plants can get considerably worse than the ones shown above, but the purpose of this study was simply to report the results for the year that just ended, 1981.

11-24-7  
CSO: 5100/2086

KREISKY SUGGESTS NEW REFERENDUM ON ATOMIC ENERGY

Vienna WIENER ZEITUNG in German 13 Jan 82 p 2

[Article: "Atomic Energy is a 'Hot Potato'"]

[Text] There will be no atomic electricity in Austria without a new referendum, stressed Chancellor Dr Kreisky yesterday after a meeting of the cabinet. The Austrian Socialist Party feels compelled to stick with the atomic energy ban for the duration of the legislative period. Kreisky believes that, in view of the changed energy situation, the Austrian people will have to decide within 2 to 3 years whether they can afford the luxury of a completed but unused atomic power plant. If the vote goes against turning on the plant, then obviously the people will have spoken again. Kreisky expressed the conviction that the people have already changed their minds since the 1978 vote.

Kreisky also stressed that the question of atomic waste disposal must first be clarified. Numerous new technologies are known, and there exists a certain willingness on the part of the Americans to help solve this problem. Aimed at Reagan, the Chancellor said, "One cannot say on the one hand that you cannot make a natural-gas dual and then on the other hand leave us to solve the problem by our own devices." The chancellor stressed that there have been no discussions in this direction since: "The Austrian Government can not do what it has not had an opportunity to do."

The chancellor pointed out that Austria may need more than one atomic power plant since experts have told him that three may be required. This will have to be decided by a vote of the people.

Yesterday, a spectrum of positions on this topic was voiced by the various political groups. Liberal Party Chairman Steger asserted that if a coalition with the Socialist Party depends on the freedom to vote yea or nay, then there will be no coalition. Liberal voters can rest assured that this party will not vote for atomic energy in any committee. The Socialist Party has coupled its fate with Zwentendorf, and also the People's Party is no guarantee that Zwentendorf will not go into operation. Only the Liberal Party consistently opposes it.

Socialist Youth Chairman Josef Cap stood behind his organization's "no" on Zwentendorf. He also spoke out against Kreisky's coupling his bid for reelection with turning-on Zwentendorf. He is basically for a new referendum as long as the question is

properly put. Past election campaigns have specifically avoided the atomic-power issue according to Gazi. He now wonders why it is being brought into the campaign. Professor Alexander Tollman spoke in the name of the antinuclear forces for holding to the decisions already made.

In a communication yesterday, the "Unions Against Atomic Energy" sharply protested the chancellor's position on the nuclear-energy question. They declared that they will oppose his position with all the power at their disposal.

9160  
CSO: 5100/2081

REPORT FINDS NUCLEAR PLANTS EMITTING VERY LOW RADIATION

Helsinki HELSINGIN SANOMAT in Finnish 13 Jan 82 p 12

/Text/ Loviisa (HELSINGIN SANOMAT)--Last year personnel at Finnish nuclear plants received significantly less radiation than in general personnel at nuclear power plants elsewhere.

The amount of radiation received by Finnish workers on average also remain notably less than that received by workers in the Swedish nuclear power plants.

The comparison calculations made by Imatran Voima Imatra Power include Loviisa 1, Loviisa 2 and the first unit of Teollisuuden Voima Industrial Power of the Finnish plants. Their personnel received average radiation of 54 manrem /roentgen-per-hour-at-1-meter?/ in all.

Respectively, the total average radiation received by the personnel of 7 Swedish plants included in the comparison was 176 manrem.

Manrem is a unit which is calculated by totaling the amount of radiation received during the year by all personnel in the nuclear power plant. In Loviisa, for example, 700 persons in all received radiation last year. The number of personnel was at its peak during the annual service period when there were over 1,000 persons working at the plant.

Imatran Voima included in its comparisons of the Nordic nuclear power plants only those which changed fuel during last year. Changing of nuclear fuel normally increases radiation. Teollisuuden Voima's second unit did not change fuel and so its amount of radiation, which would lower the average, was not included in the comparison.

Imatran Voima also compared the radiation amounts received by Finns with those caused by comparable light water reactors in the United States. In 1979 the average of the total amount in 67 American plants was 593 manrem.

Phil Lic Bjorn Wahlstrom of Imatran Voima estimates that the annual average total of radiation received by the Loviisa personnel probably will stay at about 100 manrem. Then the extra radiation on average received by personnel corresponds to the yearly radiation amount received by them from the environment.

However, the current maintenance expenses already indicate that radiation amounts received by nuclear power plants personnel may vary notably every year depending on how extensive the service and repair work is.

There are experience from other countries about variations where radiation amounts may increase from 150 manrem to 1,300 manrem the following year and then decrease to less than 300 manrem the year following to that. In comparison to these figures the figure of 36 manrem can be presented, Loviisa 2's total radiation last year.

Mechanics Olle Olsson and Kurt Aronson, who have worked at several Swedish plants say that the Loviisa situation is astonishingly good. The amounts of radiation in installation work in Loviisa remain notably lower than in most Swedish plants.

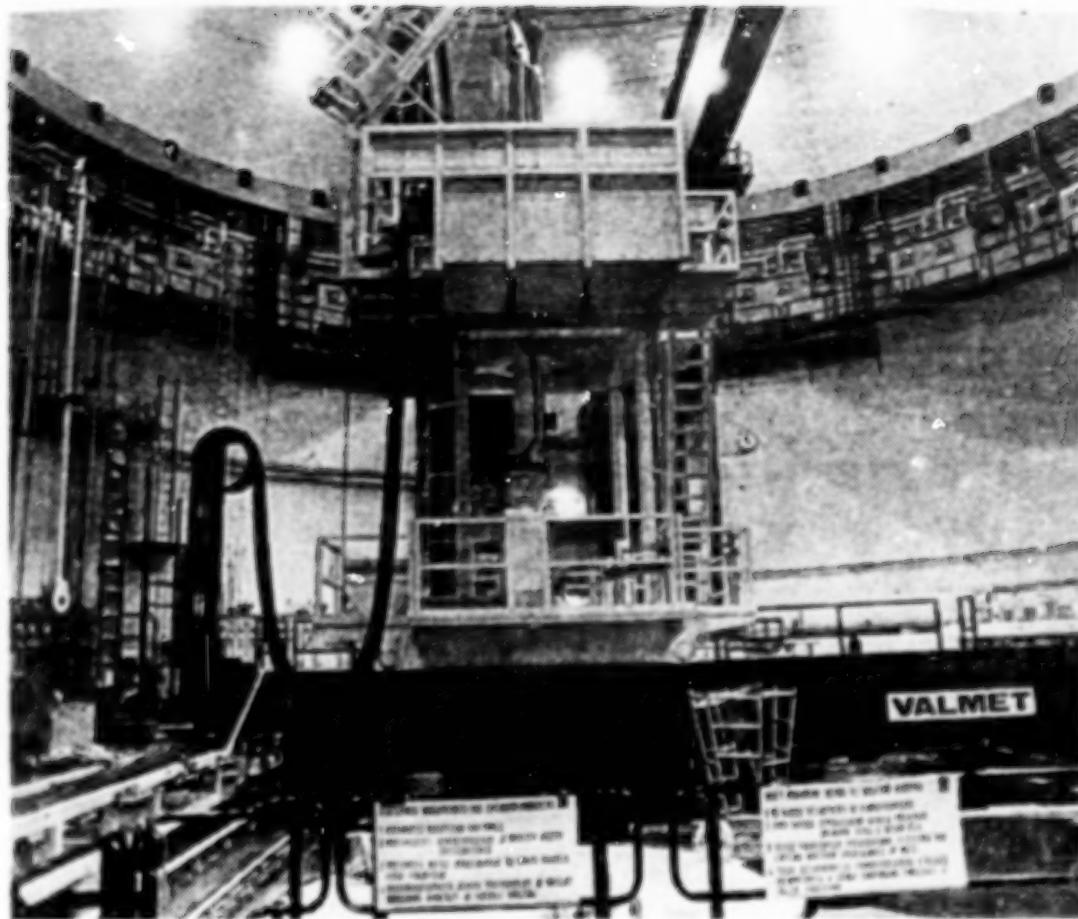
According to Kurt Aronson it is, however, difficult to compare nuclear plants off-hand, because hydraulic pressure reactor plants like Loviisa have smaller radiation sensitive areas than do general Swedish boiler plants.

#### Concrete Insulates Radiation

In the hydraulic pressure plants the water traveling through the reactor travels in its own circuit and the water revolving in the turbines travels in its own circuit. In hydraulic boiler reactors the water traveling through the reactor also circulates in the turbines.

According to Phil Lic Wahlstrom the small amount of radiation can be explained among other things by the fact that the plants' nuclear fuel has had no significant leaks and the water traveling through the reactor has been kept clean in other respects, too.

A bulk of radiation insulating concrete has also been used in the constructions of Loviisa and the importance of decreasing the radiation has been recognized. A successful choice of pipe materials of the radioactive circuit also has decreased the radiation.



Key: (1) Those working in the premises of the Loviisa nuclear power plant last year received only approximately one half of the radiation received by workers in Swedish power plants. Pictured is the Loviisa 1 reactor hall.

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**DATE FILMED**

MARCH 8, 1982

